SIGACE CODE FOR GENERATING HIGH TEMPERATURE ACE FILES; Validation and Benchmarking

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Monte Carlo code system for Neutron and Photon transport (MCNP[1]) have been extensively used for many years in the field of nuclear engineering and reactor design. The MCNP code package requires the nuclear reaction cross section data in a special formatted file known as the ACE (A Compact ENDF) format. The ACE data library is generated by processing the evaluated nuclear data file in ENDF[2] format using the NJOY[3] code system; usually processed at zero degree Kelvin or at 300K. However, many areas of studies such as ADSS (Accelerator Driven Sub-critical System), Fusion reactor blankets and Fast reactor design require nuclear cross section data at some higher temperature.

A code named SIGACE has been developed as a tool for MCNP users within the scope of a research contract awarded by the Nuclear Data Section of the International Atomic Energy Agency (IAEA) (Ref: 302-F4-IND-11566 B5-IND-29641). A new recipe has been evolved for generating high temperature ACE files. The low temperature ACE file is first converted to ENDF formatted file using ACELST code and then Doppler broadened to any desired higher temperature using SIGMA1[4]. SIGACE processes the ENDF and the ACE file to generate high temperature ACE data file for use with the MCNP code. SIGACE code also has a thinning option for the ACE file.

The SIGACE code and the recipe have been validated and benchmarked using the SEFOR fast reactor benchmark problem (Sodium cooled fast reactor benchmark described in ENDF-202/BNL-19302, 1974 document). The SIGACE generated high temperature nuclear data files were used to calculate the Doppler coefficient for the SEFOR fast reactor benchmark problem. The experimental Doppler coefficient and the computed value show good agreement. The Doppler coefficient of the SEFOR reactor calculated using the NJOY generated ACE files also agree with our SIGACE computed results. The code and the recipe is further validated and benchmarked against the numerical benchmark configuration of selected idealized PWR pin cell configurations with five different fuel enrichments as reported by Mosteller[5] and Rahnema[6]. The SIGACE package is available, free of cost, upon request, from the Nuclear Data Section of the IAEA.

References:

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